ORIGINAL ARTICLE

Patient Care at the 2010 Love Parade in Duisburg, Germany

Clinical Experiences

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SUMMARY

Background: The mass panic at the Love Parade 2010 attracted a great deal of public attention in Germany and abroad. The goals of this paper are to summarize the available data on the injured persons and their treatment, and to assess the preparations that should be made for such an eventuality and the acute measures that should be taken if it occurs.

Methods: Patient data from the Duisburg hospitals were subjected to a structured statistical analysis, and all of the measures taken were assessed by qualified evaluators on the basis of questionnaires, a consensus conference, and individual interviews of the clinical coordinators.

Results: A total of 250 000 persons took part in the Love Parade; 5600 patient contacts occurred at first-aid posts and 473 patients (mean age, 25.5 years; male:female ratio, 1.4:1) were treated in 12 hospital emergency rooms, 41.7% were admitted to the hospital. Among the admitted patients, 73% stayed in the hospital for less than 24 hours, and 41% signed out against medical advice; 62.2% had a surgical diagnosis, 40.6% a medical one, and 8.0% a psychiatric one (some patients had more than one diagnosis). 47.6% of the surviving patients were classified as mildly injured, 47.8% as moderately injured, and 4.0% as severely injured. Most medical activity was concentrated in three areas: the treatment of drug abuse, the care of many mild and moderate injuries, and Shock Room diagnostic assessment of patients potentially harboring serious injuries. Hospitals were subject to the highest strain 2 to 3 hours after the mass panic, at which time they received up to 20 new patients per hour.

Conclusion: These data permit a detailed view of the medical care that was provided. In situations of this kind, the main problems can be dealt with through targeted and structured preparation and optimized emergency plans which consider both foreseeable and unforeseeable events. Priority must be given to rapid diagnostic assessment and clinical decision-making; the prerequisites for these are transparent institutional structures and clear assignments of responsibility.

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The Love Parade 2010 was a challenge for both the emergency services and the hospitals involved. The festival, which involved 250 000 participants from all continents of the world, was the scene of a mass panic in a narrow stretch of tunnel, leading to 21 dead and more than 400 injured. This corresponds to level 4 of the German Red Cross's mass casualty incident severity scale. Recent literature contains extensive information on mass incidents (1–3). Disasters on a similar scale to that of the Love Parade 2010 include those at the Roskilde Festival in 2000, Brussels' Heysel Stadium and Bradford in 1985, and Sheffield in 1989 (4). However, the number of publications on the subject that can actually be made use of seems to be relatively low (5). As yet the literature offers no structured evaluation of patient flows and diagnoses that also includes preparations for the actual event.

This article aims to provide a structured overview of the number, severity, and urgency of treatments and to assess the measures taken by hospitals, in order to provide a medical appraisal and thereby give the best possible recommendations for planning future mass events.

This paper does not investigate the causes of the disaster.

Methods

The treatment data (age, sex, time of presentation to hospital, department providing treatment, length of inpatient treatment, diagnoses according to ICD [International Classification of Diseases]) of the patients treated at the Duisburg hospitals involved was subjected to structured collation and evaluation. The authors assigned a severity level (1 = mild, 2 = moderate, 3 = severe) to each diagnosis.

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BOX

Evaluation of measures taken

- **Essential**
  - Central coordination for each hospital, with sufficient financial margins and direct access to the administrators
  - Cooperation between hospitals, fire service and municipal authorities, prior arrangements made centrally
  - (Possibly joint) training on modern drugs
  - Staff numbers in the admission unit increased to 1.5 to 2.5 times normal levels; additional staff for transport, processing admissions, and X-rays
  - Number of physicians in the admission unit increased to between 2 and 3 times normal levels
  - Creation of additional admission capacity using temporary admission stations, additional available inpatient beds, or an external tent
  - Extra material stocks (disposable suturing sets, ankle and shoulder splints, walking aids, prepadded orthopedic casts, tissue adhesives, suture strips/butterfly stitches)
  - Preparations announced in hospital, street blocking plans distributed (allow for normal shift changes)
  - Emergency plan for mass casualty incident
  - Psychological crisis intervention offered for patients and employees
- **Beneficial**
  - Additional doctor call service
  - Admission station on the same level as the emergency room, so that no lifting is needed
  - Postpone major operations so that intensive care respiration capacity is kept ready
  - Emergency services take blood, materials provided by hospitals
  - Routine inpatient monitoring (laboratory tests, ECG, X-rays) not scheduled for the day of the event
- **No difference**
  - Additional cleaning staff
  - Breathalyzer in ambulance
- **Not useful**
  - Additional operating and sterilizing capacity
  - Having patients fill out checklists themselves for acute and self-reported medical histories and drug histories
- **Counterproductive**
  - None

Each diagnosis was also assigned to a field of internal medicine (cardiology, gastroenterology, neurology, pediatrics), surgery (trauma and visceral surgery, neurosurgery, ENT, ophthalmology, oral and maxillofacial surgery), or psychiatry. Intoxication due to use of psychoactive substances (ICD F10–F19.9) was assigned to internal medicine, because initial intensive care treatment for this is usually performed by internal medicine specialists.

The resulting data are shown using descriptive statistics. All relative values were calculated on the basis of the relevant samples. For example, the authors used all patients' data to calculate main diagnoses but only patients with complete diagnosis statistics when calculating secondary diagnoses.

To evaluate the preparations made and the measures taken, the hospitals involved held a consensus conference three weeks after the Love Parade, and a written appraisal was compiled on the basis of questionnaires. This included an assessment of all the measures by consensus, using a Likert-type scale (essential, beneficial, no difference, not useful, counterproductive).

Patients were allocated to the Love Parade or to hospitals' normal patient admissions on the basis of the emergency services' transport reports and medical histories provided by patients and third parties. Only patients who were at the site of the Love Parade or immediately adjacent areas and whose first contact with a Duisburg hospital was after 9 a.m. on July 24, 2010 and before 9 a.m. on July 25, 2010 were included in the study.

Results

An estimated 250 000 people took part in the Love Parade 2010 (6). According to the emergency services' plans there were 30 first-aid posts on site, each with capacity for 10 patients, as well as one on-duty physician, 20 first-aiders, and one ambulance, and in addition, two standard emergency treatment stations for 50 patients each (BHP 50, a category established by the German Institute for Standardization [DIN, Deutsches Institut für Normung]). These facilities registered a total of 5600 patient contacts over 24 hours. The 1600 members of auxiliary staff were increased to approximately 4000 after news of the mass panic was received. Seventy ambulances and other emergency vehicles and nine emergency helicopters were used.

All 12 involved hospitals took part in the retrospective assessment, with a total of 11 coordinators (some representing more than one hospital in the hospital network). Nine hospitals (75%) provided surgical care, two (17%) neurosurgical care, 10 (83%) internal medical care, and four psychiatric care. The evaluation of hospitals' preparations is shown in the *Box*.

Overall, it was estimated that hospitals achieved maximum capacities with staff numbers between 2 and 2.5 times normal levels for 24 hours. Increasing staff numbers further using freelance physicians is of very limited benefit, as they are not usually familiar with local circumstances or activities.

In summary, a maximum of 29 inpatient beds plus five beds for observation and three for artificial respiration, were needed per hospital in connection with the Love Parade 2010.

Table 1 presents the key data of the patients treated in Duisburg hospitals.

The distribution of main diagnoses by specialized field is shown in *Figure 1*. This shows the number of patients treated in each specialized department. Where more than one department was involved, the department leading treatment was used.

Table 2 shows the diagnoses grouped together by code. A single patient may have more than one diagnosis (e.g. multiple injuries to the extremities). The weighting of each diagnosis group in relation to the number of patients and the proportion of coded diagnoses is given here.

Table 3 displays the distribution of main diagnoses in the three severity levels used. All patients were allocated to fields of internal medicine, surgery, or psychiatry according to their main diagnoses.

Figure 2 shows the distribution of patients by field of internal medicine, surgery, and psychiatry and the distribution of severity levels in each one.

The average burden on hospital emergency rooms is shown in *Figure 3*. Peak use was 20 patients per hour in one hospital, between 7 p.m. and 8 p.m.

Discussion

The medical and organizational measures taken in connection with the Love Parade 2010 are unusual compared to other large-scale tragedies. While most mass casualty incidents are dealt with by infrastructures operating as usual, before this event major preparations and arrangements were made, as considerable numbers of patients were anticipated even if the festival went smoothly.

On the basis of experiences in previous years, no glass items were allowed at the Love Parade and many patients were expected, particularly with diagnoses in internal medicine or associated with psychoactive substance use. After the morning and early afternoon passed as expected, there was a mass panic at around 5 p.m. in the area of the Karl Lehr Tunnel, resulting in a large number of deaths and injuries. Additional emergency service staff were brought in from reserve staff and extra treatment and care capacity was created to deal with the situation. The injured were then administered first aid on site and there was coordinated transport to hospitals in Duisburg and its surroundings, where further care was provided.

One factor in particular that considerably lessened the burden on hospitals was the smooth operation of the first-aid posts and emergency treatment stations set up on site, which dealt with high numbers of patients. Although they cared for only uninjured, exhausted festival participants and all patients with confirmed or suspected need for medical attention were transported to hospitals, these facilities allowed all those involved to concentrate on their own core skills and therefore

TABLE 1

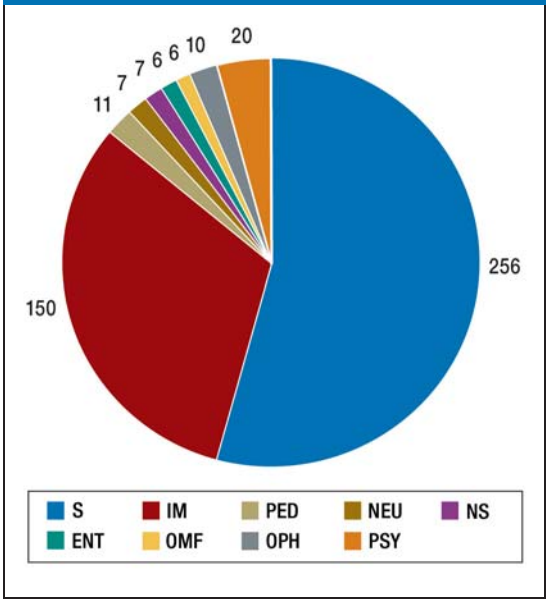
Patient data

No. of patients in Duisburg hospitals	**473**
No. of inpatients	41.7%
No. of outpatients	58.3%
Average length of inpatient stay	**24.0 hours (0.3–281.3)**
Discharged within 24 hours	73%
Percentage of these discharged within 7.2 hours	50%
Signed out against medical advice	41%
Mean age	**25.5 years (5–72)**
Male	59%
Female	41%
Patients with	
At least one surgical diagnosis	62.2%
At least one internal medical diagnosis	40.6%
At least one psychiatric diagnosis	8.0%
Only one diagnosis	71.2%
Significant pre-existing conditions	2.6%
Evaluable data available on	
Main diagnosis	100%
Main and secondary diagnoses	74.2%
Sex	74.2%
Age	85.9%
Admission and discharge status	85.9%
Time of admission or treatment	89.6%

Available relevant data were used for calculation, e.g. data on sex was available for 351 patients (74.2%); of these, 59% were male and 41% female

Number of main diagnoses by specialized department treating the patient

FIGURE 1



S: surgery/trauma surgery; IM: internal medicine; PED: pediatrics; NEU: neurology; NS: neurosurgery; ENT: ear, nose & throat; OMF: oral & maxillofacial surgery; OPH: ophthalmology; PSY: psychiatry

TABLE 2

Distribution of diagnoses (one patient may have more than one diagnosis)

	Patients	Percentage of patients (n = 473)	Findings	Percentage of diagnoses (n = 655)
Abuse of psychoactive substances (abuse and intoxication)	140	29.6	152	23.2
Injuries to the extremities	131	27.7	142	21.7
Cuts & superficial injuries	89	18.8	99	15.1
Cranial, facial & throat injuries	64	13.5	86	13.1
Chest injuries	40	8.5	40	6.1
Panic & anxiety disorders	36	7.6	37	5.6
Abdominal/pelvic injuries	29	6.1	33	5.0
Fractures, dislocations & ligament injuries	27	5.7	30	4.6
Cardiac diagnoses (e.g. collapse, angina pectoris, arrhythmia)	18	3.8	18	2.7
Spinal injuries	12	2.5	14	2.1
Eye/ear injuries	11	2.3	11	1.7
Generalized neurological complaints (e.g. seizures)	10	2.1	10	1.5
Pulmonary diagnoses (e.g. asthma, respiratory failure)	8	1.7	8	1.2
Hypovolemia	3	0.6	3	0.5

made it possible to provide all patients with almost ideal care, given the circumstances.

Analysis of patient flows over time *(Figure 3)* shows that after the mass panic at 5 p.m. there was a decline in patient numbers, which did not reach their peak until between two and three hours later. This is because central first-aid posts were set up on site (7–12) and there was then organized patient transport from the site, in accordance with current recommendations (13–15). However, there was no perceptible reduction in the burden on hospitals as a result of the low number of patients in the first hours, because although fewer patients were initially transported, those who were transported were more seriously injured. The immediate formation of trauma teams (16) and preparation of other (emergency) trauma rooms made it possible to control patient flows appropriately in all hospitals.

Although preparation on the basis of experience from previous Love Parades in Dortmund and Essen (estimated 80% of emergencies relating to internal medicine, 20% to surgery) concentrated on internal medicine, the events themselves required considerably higher levels of surgical diagnosis and treatment *(Figure 2)*. Although in retrospect there was a comparatively high proportion of patients with minor injuries *(Table 3)*, in a majority of these patients severe blunt trauma (intra-abdominal bleeding, hemothorax/pneumothorax, pulmonary contusion) had to be ruled out, requiring full trauma room diagnostic examination. For this reason, the injury severity as finally diagnosed is not an appropriate measure of initial consumption of medical resources, which must be considered significantly higher.

The high proportion of patients diagnosed with abuse of or intoxication from psychoactive substances demonstrates drug problems. The essential difficulty here was the large number of cases; significant problems in the form of complex multiple intoxication with indistinguishable symptoms did not occur, which meant that suitable treatment could be provided by physicians who were not specialists in treating psychoactive substance intoxication. Previous advanced drug training was rated as important and positive. On the one hand, this means physicians have more in-depth specialized knowledge, and on the other it dispels uncertainties when dealing with patients (which slow down the work) and so speeds up decisions and processes. As swift treatment of such patients is a high priority, this advanced training should be recommended when preparing for other, similar events.

Work was made substantially easier by the fact that the patient population was young (median age 23.0 years) and healthy. Codes for significant pre-existing secondary diagnoses were given for only 9 patients (2.6%). Although this does not rule out the existence of other secondary diagnoses, these did not cause any consumption of medical resources. On the one hand this means patients could be treated swiftly, but on the other it does not release staff from their duty to take a complete medical history to ensure that no relevant

information is overlooked. For example, drug allergies were not recorded for all patients. This means that the total proportion of patients with significant secondary diagnoses should be assumed to be higher.

The chief problem in internal medicine was psychoactive substance abuse, which was present in 29.6% of patients. Although psychoactive substance abuse itself often does not require treatment, it does affect patients' diagnoses and compliance, meaning that other symptoms may be overlooked. This is also the reason for the high number of inpatients signing out of hospitals against medical advice.

Turning to surgery, superficial wounds and injuries to the extremities were very common. The main problem, however, was not treating these injuries but ruling out serious injury in a large number of patients. There are no codes for this. In comparison, less medical resources were consumed by the actual care provided for injuries. It is therefore important that emergency plans include adequate rapid structures and that they are made as efficient as possible when preparing for mass events (16, 17) so that there are sufficient resources available for the actual treatment required by the injured.

A weak point of the research might be the incomplete nature of the database, the result of different hospitals transferring different scopes of data. However, at least three quarters of all patient data were successfully collated in all areas. In our opinion, the high number of patients and the qualified evaluation of the data by experienced physicians mean that valid conclusions can be drawn from this data pool. The literature contains no previous statistics on mass disasters with comparable levels of detail.

In retrospect, the measures taken in all fields seem to have been sufficient. Even peak demand was dealt with appropriately by hospitals and the emergency services. The many hospital employees who spontaneously travelled to their places of work after hearing of the disaster and provided support deserve praise.

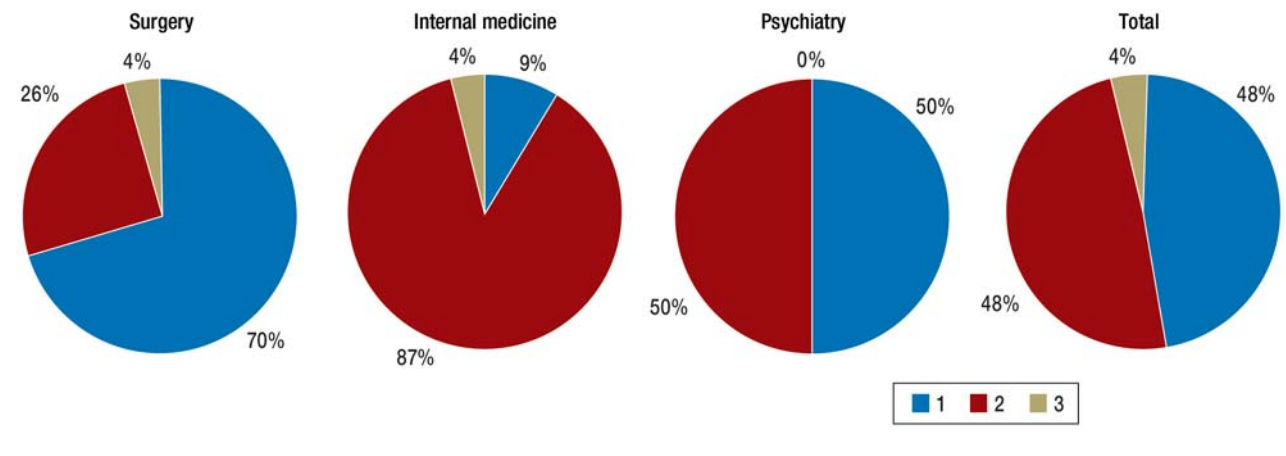
TABLE 3

Severity of main diagnoses

	Level of severity		
	1	2	3
Outpatient			
Surgical fields	87.2%	12.8%	0%
Internal medical fields	8%	92%	0%
Psychiatric field	76.9%	23.1%	0%
Inpatient			
Surgical fields	25.7%	60.0%	14.3%
Internal medical fields	4.5%	89.9%	5.6%
Psychiatric field	22.2%	77.8%	0%

1: Mild complaints that can be treated on an outpatient basis (e.g. bruising, muscle strains, alcohol abuse; NACA 0–I)
2: Moderate complaints that require medical intervention or inpatient treatment (e.g. radial fracture, hypoglycemia, panic, seizures, mild concussion, blunt abdominal trauma; NACA II)
3: Acutely dangerous complaints that require emergency surgery or observation (e.g. cerebral edema, hypoglycemic coma, compound intoxication, acute abdominal symptoms; NACA III or higher)

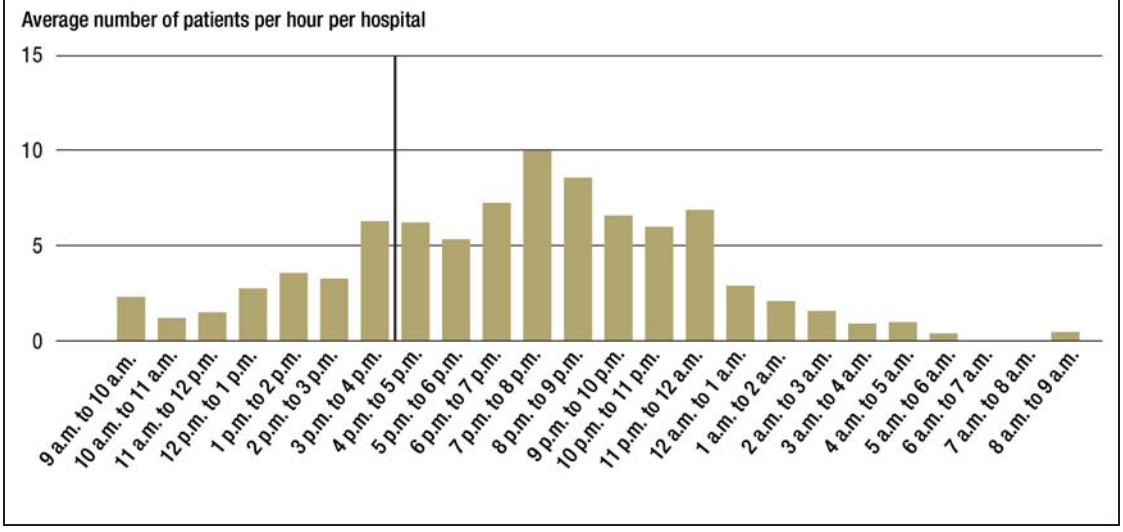
FIGURE 2



Distribution of patients by field of specialization within internal medicine, surgery, and psychiatry. Levels of severity as in Table 3

Burden on hospitals

FIGURE 3



Overall, hospitals achieve maximum capacities with staff numbers between 2 and 2.5 times normal levels. Local hospitals cannot deal with higher demand. It should be debated whether organizers or authorities granting authorization ought to be informed and whether logistical and financial assistance ought to be demanded.

The communication policy surrounding the event is also subject to criticism. It is quite clear that the participant numbers reported in Duisburg were substantially exaggerated, as they had been for the events in Essen and Dortmund. This makes it impossible to plan hospital capacities realistically. The lack of accurate reporting results in an additional risk, because when past figures based on falsely high numbers of participants are reviewed the treatment capacities for future events are planned for insufficient numbers, endangering patients.

A central aspect of future common preparations must therefore be comprehensive, accurate information from hospitals and physicians involved.

Medical practices

While hospitals are always involved in providing care, physicians with their own practices are only affected in the few cases in which a mass event is held during regular consultation hours. Because of their longer opening hours, surgical insurance accident consultants' practices are particularly likely to be affected, and they should therefore also make preparations. Plans must be based on the premise that the emergency services' transport capacity will be severely limited. This means there should be clear arrangements for admission to collaborating hospitals. Routine appointments should be avoided, and an experienced employee should be designated for patient admission and triage. It is advisable to inform patients already in the waiting room in advance. Rapid wound care and plaster casting techniques may also be advantageous.

Summary

Patient care by hospitals and the emergency services was adequate. The main clinical factors were consumption of psychoactive substances and the high number of patients with potentially serious injuries.

Conflict of interest statement
The authors declare that no conflict of interest exists.

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